

Syllabus
MATH 8170: Stochastic Models in Operations Research I
Fall 2019, Section 001

Instructor: Brian H. Fralix

Instructor's Office: Martin O-310

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Office Hours: 3:30PM - 4:30PM Mondays through Thursdays, and by appointment.

Course Location and Meeting Time: Martin M-103, 10:10AM - 11:00AM MWF.

Course Website: <http://bfralix.people.clemson.edu/math8170.htm>.

Textbook: *Introduction to Probability Models*, 12th Edition, by Sheldon Ross. You are welcome to make use of an earlier edition of the text if you'd prefer to do so: problems assigned for homework will be written out in full (i.e. I will not be referring to page and problem numbers in the text when I write up each assignment) and posted online.

Keep in mind also that I will provide you with a .pdf file that contains my own notes for this course, as well as for MATH 8030. I am in the process of modifying these notes, so updates will be sent out periodically throughout the semester.

Prerequisites: MATH 8030, or consent of instructor.

Attendance Policy: I will keep a record of your attendance, but this will have absolutely no impact on your grade.

Late Instructor: If the instructor is late, students should wait 15 minutes before leaving.

Course Description: This course will serve as an introduction to Renewal Theory (focusing on renewal arguments, Blackwell's Theorem and the Key Renewal Theorem), Continuous-time Markov Chains, and Brownian Motion.

Regarding Prerequisites: The main prerequisite for this course is MATH 8030, along with a reasonable level of mathematical maturity. In other words, you should be reasonably comfortable with understanding and constructing proofs, particularly $\epsilon - \delta$ type proofs often encountered in an analysis course.

Goals and Learning Objective: At the end of the course, students should leave with a sound understanding (both intuitive and mathematical) of renewal processes and renewal theory, continuous-time Markov chains and Brownian motion.

More precisely, upon completion of this course students should be able to do the following:

- Understand what a renewal process is, and how to identify one within a given stochastic process.
- Use renewal processes to compute various types of long-run-averages associated with stochastic models, and understand the connection between such ideas and the Strong Law of Large Numbers.

- Use renewal processes to construct renewal equations, and use the Key Renewal Theorem to compute limiting distributions for stochastic processes having an embedded regenerative structure.
- Understand the basics of continuous-time Markov chains (CTMCs), along with both how they are used to model random phenomena, and when it is appropriate to use them in modeling.
- Derive stationary distributions and invariant measures for CTMCs, and understand when such measures exist, and when they are unique up to multiplicative constants. Students should also understand the difference between studying the long-run behavior of continuous-time processes over the entire real line versus over a random subsequence of the real line (for example, at the arrival instants of a queueing system).
- Understand the concept of reversibility, and be able to verify when a CTMC is reversible.
- Compute basic quantities associated with Brownian motion, such as the distribution of its maximum value in a finite interval, and its associated hitting-time distributions.
- Understand what a martingale is, and how to show that a stochastic process is a martingale.
- Use the Optional Sampling theorem to compute various quantities associated with Brownian motion, and other types of martingales.

Grading Policy: The grading policy is as follows: 20 percent of your grade will be based on homework, 20 percent on Midterm 1, 20 percent on Midterm 2, and 40 percent on the Final Exam.

Your end-of-semester grades will be based on the following scale: a final grade that falls in the interval $[85, 100]$ is worth at least an A , $[80, 85)$ is worth at least an $A-$, $[75, 80)$ at least a $B+$, $[70, 75)$ at least a B , $[65, 70)$ at least a $B-$, $[60, 65)$ at least a $C+$, $[55, 60)$ at least a C , $[50, 55)$ at least a $C-$, and $[0, 49)$ an F . I reserve the right to curve upward, but keep in mind that based on past experience, the final grading scale is usually fairly close to the one given above.

Homework: Homework assignments will be announced in class, and posted on the class web site in .pdf format. I would guess that you will have six or seven homework assignments throughout the year. Late submissions will not be accepted.

Test Dates: Right now, we will plan to have Test 1 on Wednesday, October 2, and Test 2 on Wednesday, November 13. The final exam will be held on Tuesday, December 10, from 3:00 - 5:30PM in Martin M-103.

Official Statement of Academic Integrity: (*From the Graduate Announcements*) “As members of the Clemson University community, we have inherited Thomas Green Clemson’s vision of this institution as a ‘high seminary of learning.’ Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form. In instances where academic standards may have been compromised, Clemson University has a responsibility to respond appropriately and expeditiously to charges of violations of academic integrity.”

Disability Access Statement: “Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to a class should let the professor know, and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848, by emailing studentaccess@lists.clemson.edu, or by visiting Suite 239 in the Academic Success Center building. Appointments are strongly encouraged drop-ins will be seen if possible, but there could be a significant wait due to scheduled appointments. Students who receive Academic Access Letters are strongly encouraged to request, obtain and present these to their professors as early in the semester as possible so that accommodations can be made in a timely manner. It is the students responsibility to follow this process each semester. You can access further information here: <http://www.clemson.edu/campus-life/campus-services/sds/>.”

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<http://www.clemson.edu/campus-life/campus-services/access/title-ix/>.

Ms. Alesia Smith is the Clemson University Title IX Coordinator and the Executive Director of Equity Compliance. Her office is located at 110 Holtzendorff Hall, 864.656.3181 (voice) or 864.656.0899 (TDD).